

## Three new species, a new name and notes on Australian *Polycarpaea* (Caryophyllaceae)

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### Abstract

Cowie, I.D. Three new species, a new name and notes on Australian *Polycarpaea* (Caryophyllaceae). Nuytsia 9 (3): 319-332 (1994). *Polycarpaea incana*, *P. microceps* and *P. tenax* are described and illustrated and a new name, *P. multicaulis*, is chosen for the later homonym *P. microphylla* Pedley. Variation in these taxa, as well as *P. breviflora*, *P. corymbosa*, *P. involucrata*, *P. spirostylis* and *P. violacea* is discussed. A key to Australian species is included.

### Introduction

The genus *Polycarpaea* was described by Lamark (1792) and has since been conserved against the earlier name *Polia* Lour. (Rickett & Stafleu 1959). The name *Polycarpaea* has been used in Australia since Mueller's (1859) treatment of the genus, with subsequent accounts by Bentham (1863), Domin (1925) and Pedley (1977). Although Kuntze (1891) transferred many species to *Polycarpa* (an orthographic variant of *Polycarpon*), his treatment appears not to have been widely applied to Australian material. Since Pedley's paper was published many specimens have been collected from more remote parts of northern Australia, especially Arnhem Land and the Kimberley Region. Although a treatment for the "Flora of Australia" is in preparation, this precursory paper allows more complete descriptions of new taxa and discussion of patterns of variation and synonymy in several other taxa.

The study was based on the gross morphology of herbarium specimens and measurements were derived from dried and detergent softened material. The morphology of the seed testa was considered of possible taxonomic value. Seeds were therefore examined using a scanning electron microscope.

The conservation status of new taxa was assessed and coded using the criteria and abbreviations of Briggs and Leigh (1988)

## Morphology

*Habit.* Most species are annual or perennial herbs, although *P. multicaulis* is an erect, many-stemmed subshrub with a woody base. Among the annual species, lifeforms range from few-stemmed, erect and slender (most forms of *P. corymbosa*, *P. longiflora*, *P. staminodina* and *P. violacea*) to low and bushy (*P. arida*, *P. involucrata*). This range of variation may often be present within the one species (e.g. *P. spirostylis*, *P. breviflora*, *P. holtzei*). The perennial species are usually small, and are wiry with numerous stems arising from a woody base.

*Indumentum.* All species are hairy to some degree, ranging from almost glabrous (*P. breviflora* and *P. spirostylis*) to hoary and woolly (*P. incana* and *P. tenax*). Hair types in the genus consist of branched and unbranched crisped septate hairs. *Polycarpaea breviflora* and *P. spirostylis* have tufts of branched hairs in the leaf axils but are otherwise glabrous. At least the stems of all other species are thinly pubescent to woolly with branched hairs. The stipules, bracts and sepals of most species are glabrous (often with ciliate or fimbriate margins) but may be hairy in *P. staminodina* and *P. tenax*. The leaves of most species have simple and/or branched hairs except those of *P. arida*, the common annual form of *P. corymbosa* and *P. holtzei* which are glabrous. The stipules and bracts of *P. holtzei* commonly have a long bristle arising from near the base on the abaxial surface.

*Leaves.* Basal leaves are often present on young plants but are lost on older plants. In shape, they range from oblanceolate to orbicular. In most species found on sandstone outcrops (*P. incana*, *P. microceps*, *P. multicaulis* and *P. tenax*), cauline leaves are short, stiff, opposite and are narrowly oblanceolate or linear. Cauline leaves are relatively long, soft, linear and whorled in most other species. In *P. arida* and *P. involucrata* the cauline leaves are whorled but are otherwise similar to those of the sandstone species.

*Inflorescences.* Variation in compactness and placement of inflorescences and the presence or absence of floral leaves can be of some value as taxonomic characters. Inflorescences vary from reduced and capitate (in *P. incana*, *P. involucrata*, *P. microceps*, and *P. tenax*) to open (*P. breviflora*, *P. corymbosa*, *P. longiflora*, *P. spirostylis* and *P. violacea*). However, among the latter group there is often variation in density within a species with some forms having relatively compact (but not capitate) inflorescences. Those of *P. arida* and *P. holtzei* are intermediate in compactness, and in common with the 'capitate' species, have one or more pairs of subtending floral leaves. Most species have terminal inflorescences whilst those of *P. arida* and *P. involucrata* are axillary as well as terminal.

*Flowers.* Sepals within the genus are relatively constant in shape, but vary in colouration and the prominence of the midrib. The midrib may be accentuated by red or pink colouration in some forms of *P. breviflora*, *P. corymbosa*, *P. longiflora*, *P. spirostylis* and *P. violacea* but appears less prominent in forms and species with hyaline sepals. The base of sepals is often thickened and yellowish but varies within a species. Discrete red-brown resinous exudates are often present between the outer sepals and at the nodes. However, except for *P. arida* where they are always absent, the presence or absence of exudates is not consistent within a species. Petals are narrowly triangular to oblong and the apices may be bifid (some forms of *P. breviflora* and *P. spirostylis*), entire or erose. In *P. breviflora*, *P. longiflora*, *P. spirostylis* and *P. tenax* the petals and staminal filaments are adnate at their bases to form a short tube, ranging from 0.5 mm long in *P. tenax* to 7 mm long in *P. spirostylis*. *Polycarpaea violacea* and *P. staminodina* have minute linear staminodes 0.2 to 0.6 mm long inside the base of each petal. *Polycarpaea arida*, *P. corymbosa*, *P. holtzei*, *P. incana*, *P. involucrata*, *P. microceps*, *P. multicaulis* and *P. tenax* have a minute corona c. 0.05 mm long inside the corolla.

**Fruit.** Capsules in most species are ovoid or ellipsoid, while in some forms of *P. corymbosa*, *P. longiflora*, *P. spirostylis*, *P. staminodina* and *P. tenax* capsules are narrowly ovoid before dehiscence, often becoming urceolate once the valves open. *Polycarpaea holtzei* is unusual in having ellipsoid to narrowly obovoid capsules, probably the result of the solitary seed.

**Seeds.** Numbers of seeds per capsule vary from 1 in *P. holtzei* to 30 in *P. tenax*. Seed numbers mostly fall in the range 10-20, although *P. violacea* can have as few as 4 and *P. corymbosa* as few as 6, while *P. incana* can have up to 27. Except for *P. tenax* and *P. holtzei*, seed number does not appear of great value as a taxonomic character. The shape of seeds within the genus varies from almost discoid (*P. longiflora* - Figure 1A and *P. violacea*) to subcylindrical (some forms of *P. staminodina* - Figure 1B and *P. corymbosa*) but is often relatively constant within a species or group of species. Seeds of some species are comma-shaped in outline (*P. spirostylis* - Figure 1C) while others are dimidiate (*P. incana*, *P. tenax* - Figures 1E, F). The testa can be almost smooth as in *P. holtzei* (Figure 1H) but is more usually ornamented. In some forms of *P. longiflora* it is reticulate-areolate (Figure 1A), while that of *P. tenax*, *P. multicaulis* and *P. microceps* (Figures 1E-G) is reticulate-areolate or reticulate-foveolate with a minute reticulum. It is reticulate-areolate or reticulate-foveolate and minutely muricate in some forms of *P. breviflora*, *P. spirostylis* (Figures 1C, D), *P. corymbosa* and *P. longiflora*.

### The perennial xerophytic lifeform

The perennial species of *Polycarpaea* display a distinct xerophytic lifeform. They are small, wiry, microphyllous, have numerous stems, reduced inflorescences, often have a dense hoary indumentum and resprout each wet season from a woody base. These perennial species have close affinities with the annuals *P. involucrata* and *P. corymbosa*, and with which some species intergrade (as discussed below). Characters linking the perennial species to *P. corymbosa* and *P. involucrata* (and to a lesser extent *P. arida* and *P. holtzei*) are the presence of a minute corona between the stamens, the usual lack of a floral tube (except *P. tenax*), the lack of staminodes, ornamentation of the seed testa and seed shape. In addition, *P. involucrata* has the reduced inflorescences common to the perennial species and has a similar growth habit and occupies a similar habitat. Although *P. tenax* is anomalous among these species in having a short floral tube, the presence of the characters discussed above indicates that it is otherwise closely related. These species (as well as *P. arida*) are best placed with *P. corymbosa* and *P. involucrata* in *Polycarpaea* section *Polycarpia* as recognised by Bentham (1863).

Perennation and xeromorphy in the species occurring on rock outcrops appears to be related to climate. *Polycarpaea involucrata*, an annual, occurs largely in drier areas receiving 200 mm to 800 mm annual rainfall while the perennial species occur mainly in higher rainfall areas receiving 800 mm to 1400 mm annual rainfall (although some forms of *P. multicaulis* are exceptions) (Plumb 1977). However, even in the higher rainfall areas the climate is strongly seasonal with a dry season of 5 to 7 months duration. It seems unlikely that life history is related to habitat or soil fertility as the substrate and habitat (crevices in sandstone outcrops) are very similar for all the species involved. It is postulated that in the drier areas the climate is too extreme to support perennials and that an annual life history allows plants to cope effectively with the longer dry season or irregular rainfall without the need to evolve a suite of xeromorphic characters. In the wetter areas rainfall (or perhaps dew runoff) is regular enough to support a perennial life history but the strongly seasonality has led to the development of xeromorphic characters described above. It is interesting to note that perennation has evolved on what would appear to be the most extreme habitat in the regions involved, not on a more mesic habitat.

The fragmented nature of the habitat occupied by the group has probably contributed to the genetic isolation of populations and hence the process of speciation. The residual land surfaces (commonly outcropping sandstone) occupied by these species form an archipelago of suitable habitats across northern Australia. At the species level, this isolation is reflected in the occurrence of the closely related but geographically isolated species *P. involucrata*, *P. multicaulis*, *P. incana*, and *P. tenax*. *Polycarpaea microceps* is unusual in that it is sympatric with another member of the group, *P. tenax*. Apart from morphological differences, the two occur in separate habitats, the former usually in crevices in rock faces and the latter in crevices in rock platforms. Within species, this geographic isolation can explain the many variants encountered in *P. multicaulis* and some of the variation in *P. involucrata*.

### Key to Australian species

- 1 a. Stems and leaves glabrous (except for tufts of hairs in axils of bracts and leaves); stipules <3 mm long ..... 2
- b. Stems and often leaves thinly pubescent to hoary; stipules usually >3 mm long ..... 3
- 2 a. Sepals <4.5 mm long; corolla <4 mm long ..... *P. breviflora*
- b. Sepals >4.5 mm long; corolla >4 mm long ..... *P. spirostylis*
- 3 a. Cauline leaves in 2-several pairs per node; plants usually annual; stems usually grey, green, stramineous or brown ..... 4
- b. Cauline leaves in one (rarely 2) pairs per node; plants perennial; stems often white-hoary ..... 10
- 4 a. Staminodes linear, 0.2-0.6 mm long, at the base of each petal ..... 5
- b. Staminodes absent ..... 6
- 5 a. Sepals usually >3.5 mm long; stipules, bracts and sepals glabrous ..... *P. violacea*
- b. Sepals ≤3.5 mm long; stipules, bracts and sepals hairy at least towards base ... *P. staminodina*
- 6 a. Corolla and stamens adnate at base for 1-3.5 mm ..... *P. longiflora*
- b. Corolla and stamens free or adnate at base for <0.5 mm ..... 7
- 7 a. Pedicels glabrous; seed 1, often falling as a unit with pedicel, perianth and capsule; petals <0.3 times as long as sepals ..... *P. holtzei*
- b. Pedicels hairy (flowers sometimes sessile); seeds >4, at maturity shed from capsule; petals usually >0.3 times as long as sepals ..... 8
- 8 a. Inflorescences lacking a subtending involucre of leaves ..... *P. corymbosa*
- b. Inflorescences subtended by an involucre of leaves ..... 9
- 9 a. Inflorescences capitate and sessile; leaves cobwebbed; pedicels ≤1.5 mm long ..... *P. involucrata*
- b. Inflorescences open; leaves glabrous; most pedicels >1.5 mm and up to 5 mm long ..... *P. arida*
- 10 a. Inflorescences usually open, with conspicuous, dichotomous branching, lacking subtending leaves ..... *P. multicaulis*
- b. Inflorescences capitate and sessile, subtended by a pair or involucre of leaves ..... 11
- 11 a. Stipules, bracts, sepals and stems red-brown; stems cobwebbed ..... *P. microceps*
- b. Stipules, bracts and sepals hyaline; stems white-hoary ..... 12
- 12 a. Corolla and stamens adnate at base for ≥0.5 mm; sepals 3.2-5 mm long ..... *P. tenax*
- b. Corolla and stamens free or adnate at base for <0.5 mm; sepals 1.8-3 mm long ..... *P. incana*



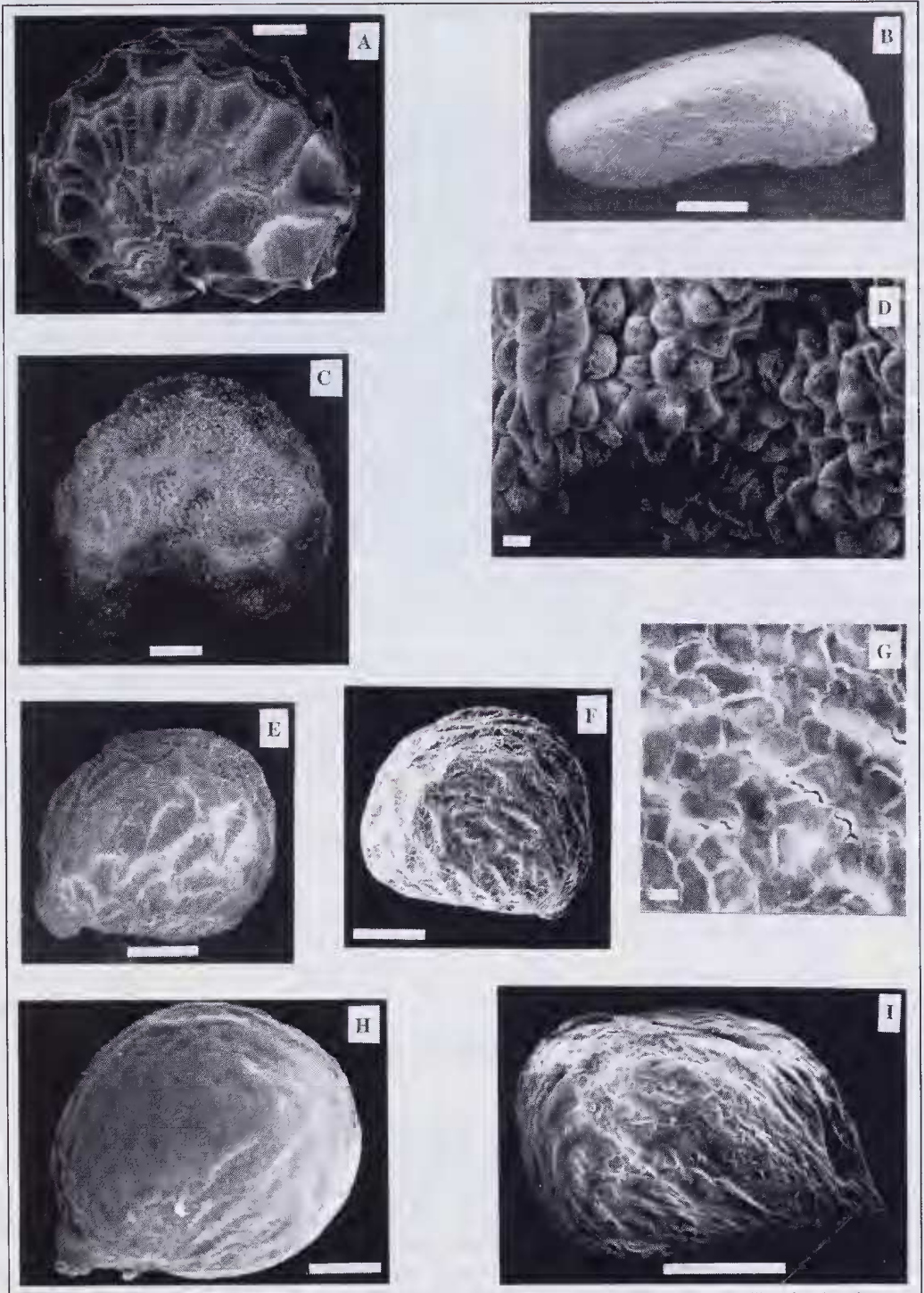


Figure 1. Scanning electron micrographs of *Polycarpaea* seeds (lateral view). A-*P. longiflora* (J. Clarkson 6552). B - *P. staminodina* (S.T. Blake 17470). C, D - *P. spirostylis* (L. Pedley 2661). E - *P. incana* (P.K. Latz 3113). F, G - *P. tenax* (M. Lazarides 9017). H - *P. holtzei* (T. Hartley 13908). I - *P. microceps* (C.R. Dunlop 3705). All scale bars are 0.1 mm, except D & G which are 0.01 mm.

## Descriptions

***P. incana*** I.D. Cowie, sp. nov.

*P. involucrata* arcte affinis, a qua imprimis differt habitu perenni, indumento incano, inflorescentiis axillaribus absentibus, bracteis ac calycibus abbreviatis, et foliis angustatis.

*Typus*: near Kurundie Creek, Kakadu National Park, Northern Territory, 20 April 1990, *G.J. Leach* 2795 & *I.D. Cowie* (holo: DNA!; iso: BRI, MEL!).

An erect perennial *herb* to 15 cm tall. *Stems* numerous, hoary, stout, 1-1.4 mm diam., with branched crisped septate hairs; internodes 1.5-10 mm long. *Stipules* hyaline, 2-3 mm long, triangular, midrib present, cobwebbed with crisped septate hairs, margins ciliate, apex attenuate. *Cauline leaves* opposite, rarely whorled, narrowly oblanceolate or linear, 2-5 mm long, 0.5-0.7 mm wide, glabrous to cobwebbed with branched or unbranched crisped septate hairs. *Inflorescence* terminal, sessile, capitate, 1-11-flowered, subtended by 1-2 pairs of leaves; bracts stipule-like, 1.8-3 mm long, thinly pubescent, bifid; pedicels 1-1.2 mm long. *Sepals* hyaline, lanceolate, 1.8-3 mm long, midrib present, margin ciliate, apex acute. *Petals* reddish, free, lanceolate to oblong, 1.2-2 mm long, 0.6-0.9 times as long as sepals, glabrous, apex rounded. *Stamens* 0.9-1.4 mm long, 0.6-0.8 times as long as petals; filaments 0.7-1.1 mm long; anthers 0.3-0.5 mm long; staminodes absent. *Style* 0.2-0.3 mm long; stigma capitate. *Capsule* brown, ovoid, 1.3-2.2 mm long, 0.5-0.8 times as long as calyx. *Seeds* 11-27, brown, dimidiate in outline, c. 0.4 mm long, 0.3 mm wide, surface reticulate-areolate or reticulate-foveolate with a minute reticulum. Figures 1E, 2F-H.

*Other specimens examined*. NORTHERN TERRITORY: Nitmiluk (Katherine Gorge) National Park, 14° 19' S, 132° 25' E, *P.K. Latz* 3113 (DNA); *N. Byrnes* 679 (DNA); 14° 19' S, 132° 28' E, *C. Dunlop* & *N. Byrnes* 2161 (DNA); 14° 20' S, 132° 30' E, *M. Evans* 3267 (DNA); 10 km SSW of El Sharana, 13° 34' S, 132° 29' E, *T.M. Orr* 358 (DNA).

*Distribution*. Endemic to the Northern Territory, in Nitmiluk (Katherine Gorge) National Park and Kakadu National Park (south of the South Alligator River).

*Habitat*. Grows in crevices in sandstone rock platforms.

*Flowering and fruiting*. Between March and May.

*Conservation status*. 3RC-t. All known populations of this species are in Nitmiluk (Katherine Gorge) National Park or Kakadu National Park.

*Notes*. Differs from *P. multicaulis* by the sessile, capitate inflorescences, presence of floral leaves and relatively shorter stamens; from *P. involucrata* by the perennial habit, hoary indumentum, narrower leaves, lack of axillary inflorescences, and shorter bracts and sepals; from *P. microceps* by the narrower leaves, thicker stems, hyaline bracts and calyx and hoary indumentum and from *P. tenax* by the lack of a floral tube, and shorter floral parts. *Polycarpaea incana* is geographically isolated by the South Alligator River valley from *P. microceps* and *P. tenax* to the north and by the Roper River valley and several other rivers from *P. multicaulis* and *P. involucrata* to the south. Two specimens from the Kimberley region of Western Australia (*Fryxell* 4726 and *Dunlop* 5241) are intermediate between

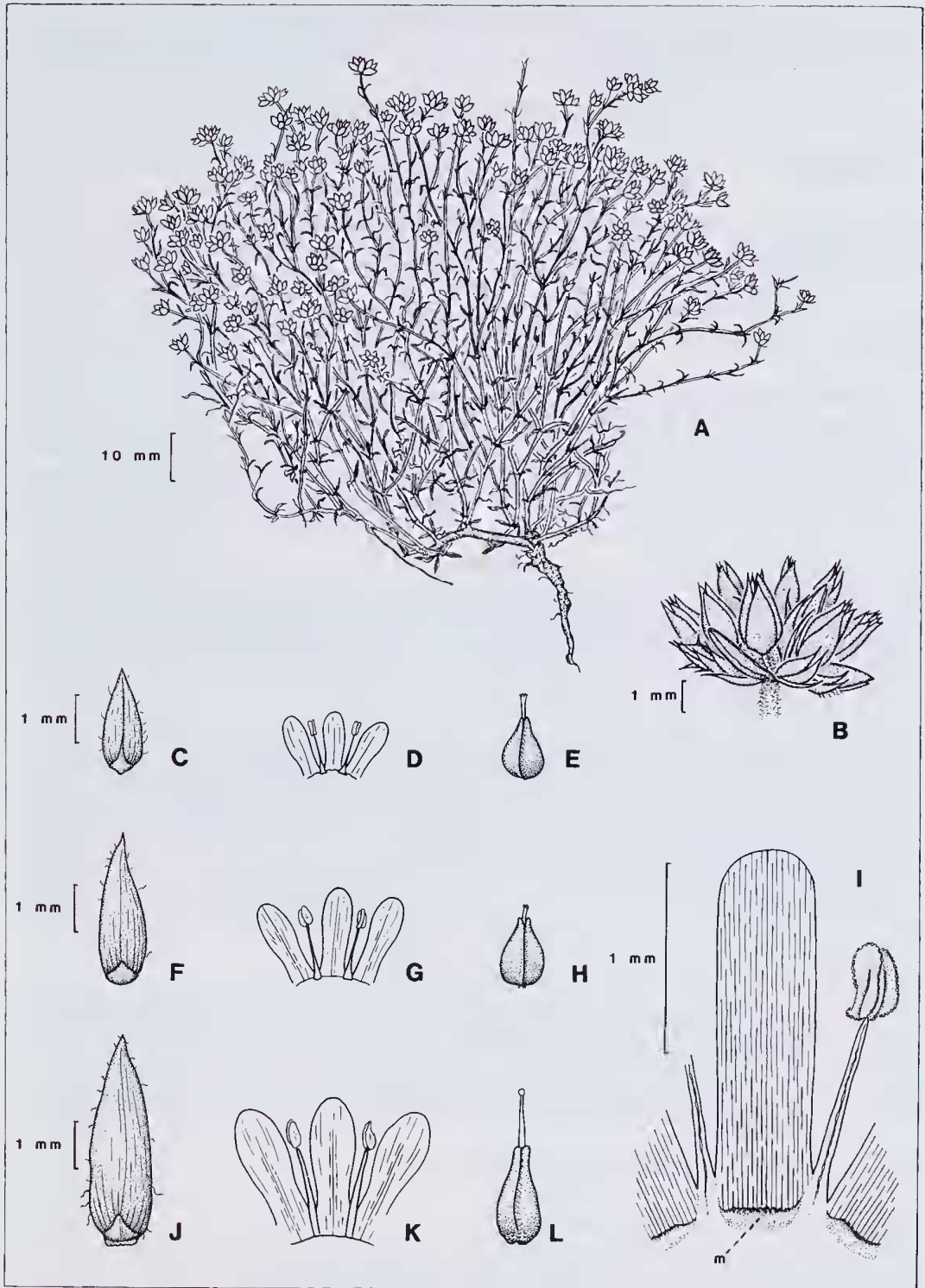


Figure 2. *Polycarpaea microcephala* A - habit, B - inflorescence, C - sepal, D - petals and stamens, E - capsule (from C.R. Dunlop 4704). *P. incana* F - sepal, G - petals and stamens, H - capsule, I - petal and stamen showing corona at base of petal (m) (from G.J. Leach 2795 & I.D. Cowie). *P. tenax* J - sepal, K - petals and stamens, L - capsule (from B. Rice 3206).



*P. involucrata* and *P. incana* in growth habit, inflorescence, floral and indumentum characters. Further collecting would help clarify the relationship of these entities to *P. incana* and *P. involucrata*.

*Etymology.* The specific epithet refers to the hoary stems.

***P. microceps*** I.D. Cowie, sp. nov.

*P. incana* affinis sed habens foliis latis, caulibus tenuibus, bracteis ac calycibus ferrugineis, et carens indumento incano.

*Typus:* Little Nourlangie Rock, Northern Territory, 17 March 1978, *C. Dunlop* 4704 (holo: DNA!; iso: BRI).

An erect perennial herb to 15 cm tall. *Stems* numerous, red-brown, slender, 0.6-0.7 mm diam., cobwebbed with branched crisped septate hairs; internodes 6-12 mm long. *Stipules* red-brown, 1.6-2 mm long, triangular, midrib present, margins ciliate, apex attenuate. *Cauline leaves* opposite, occasionally in several pairs at nodes, narrowly oblanceolate or linear, 2.3-9 mm long, 0.7-1.3 mm wide, glabrate with crisped septate hairs. *Inflorescence* terminal, capitate, 3-12-flowered, subtended by 1-2 pairs of leaves; bracts stipule-like, 1.7-3 mm long, bifid; pedicels 0.5-1.5 mm long. *Sepals* red-brown, lanceolate, 2.1-3 mm long, midrib present, margin ciliate, apex acute. *Petals* reddish, free, lanceolate to oblong, 1.2-2 mm long, 0.6-0.8 times as long as sepals, glabrous, apex rounded. *Stamens* 0.8-1.4 mm long, 0.4-0.6 times as long as petals; filaments 0.7-1.2 mm long; anthers 0.3-0.4 mm long; staminodes absent. *Style* 0.3-0.5 mm long; stigma capitate. *Capsule* brown, ovoid, 1.2-1.5 mm long, 0.5-0.7 times as long as calyx. *Seeds* c. 12, red-brown, rhomboidal-ellipsoid, c. 0.4 mm long, 0.25 mm wide, surface foveolate with a minute reticulum. Figures 11, 2A-E.

*Other specimens examined.* NORTHERN TERRITORY: 1 km upstream from Twin Falls, 13° 20' S, 132° 42' E, *R. Fensham* 781 (DNA); 70 km S of Jabiru, 13° 19' S, 132° 47' E, *L.A. Craven & G. Whitbread* 7887 (CANB); SE face of Nourlangie Rock, Kakadu National Park, 12° 57' S, 132° 50' E, *R. Cunliffe* UNSW19984 (CANB, DNA); 5 km SE of East Alligator River Crossing, 12° 25' S, 132° 55' E, *van Balgooy & Byrnes* 1314 (CANB); 2 km NW of Koongarra Saddle, 12° 45' S, 132° 55' E, *I.R. Telford* 8119 & *J.W. Wrigley* (BRI); Deaf Adder Gorge, 13° 02' S, 132° 58' E, *C. Dunlop* 4406 (BRI, DNA); Nabarlek, 12° 17' S, 133° 19' E, *M.O. Rankin* 2090 (CANB, DNA); 8 km E of East Alligator River Crossing, 12° 25' S, 133° 29' E, *C. Dunlop* 3705 (DNA); Liverpool River Headwaters, 12° 46' S, 133° 44' E, *G. Wightman* 1441 & *L. Craven* (DNA).

*Distribution.* Endemic to western Arnhem Land in the Northern Territory, in Kakadu National Park and adjoining areas of the Arnhem Land Reserve.

*Habitat.* Grows in crevices in sandstone rock faces and rarely in crevices in rock platforms.

*Flowering and fruiting.* Between February and July.

*Conservation status.* Not rare or threatened.

*Notes.* Similar to but geographically disjunct from *P. incana* and having broader leaves, finer stems, red-brown bracts and calyx, and lacking the hoary indumentum of that species. Sympatric with *P. tenax* but differing from that species in the lack of a floral tube, smaller floral parts, red-brown bracts



and calyx and lack of a hoary indumentum. One collection, *Wightman* 1441 & *Craven*, however does have the hoary indumentum of *P. incana*.

*Etymology.* The specific epithet refers to the relatively small, compact inflorescences.

***P. multicaulis*** I.D. Cowie, nomen nov.

*Polycarpaea microphylla* Pedley, *Austrobaileya* 1:55 (1977), *nom. illeg., non* Cav., *Anales Ci. Nat.* 3:25 (1801). *Type:* Robinson River, Northern Territory, July 1925, *L.J.Brass* 415 (holo: BRI, iso: CANB!).

*Distribution.* Occurs inland of the Gulf of Carpentaria in Queensland and the Northern Territory, and in western Queensland.

*Habitat.* Grows on shallow soils on residual land surfaces, often associated with sandstone outcrops.

*Flowering and fruiting.* Mainly between April and August.

*Conservation status.* Not rare or threatened.

*Discussion.* This species is closely related to some forms of *P. corymbosa*, with which it sometimes intergrades in western Queensland. The distinctive features of *P. multicaulis* are the perennial habit, often subwoody base, typically numerous wiry stems, hoary at least in the upper parts, short stipules and leaves, few pairs of leaves per node and long petals and capsule relative to the length of the sepals. However, the two species are quite distinct over much of the range of *P. multicaulis* and are usually separated by habitat. In northern areas where *P. multicaulis* and *P. corymbosa* are sympatric, the latter is typically a slender few-stemmed annual with longer more numerous leaves, longer floral parts and lacks a hoary indumentum. A series of intermediate specimens mainly from western Queensland have many hoary perennial stems, but these have longer leaves and more pairs of leaves per node. (e.g. *Blake* 9969, *Ballingall* 1654, *Beeston* 1250c, *Bredillet s.n.* Aug.1983, *McDonald* 2620, *Palmer s.n.* 1883, *Wauchope s.n.* 10/2/1975 and *Wilson* 438 & *Pickering*). There are some short-lived perennial forms of *P. corymbosa* from eastern Queensland and New South Wales with short floral parts, but in other respects they are typical of *P. corymbosa*.

Northerly forms of *P. multicaulis* have more strongly branched inflorescences than do forms from south western Queensland. Some specimens from the Gulf of Carpentaria have reduced inflorescences and appear intermediate between this species and *P. incana* (*Brass* 415 and *Brass s.n.* Gilbert River). *Everist* 5292 may represent an undescribed species. It has the floral tube and longer floral parts of *P. tenax* but the inflorescence of *P. multicaulis* and the more numerous leaves of *P. corymbosa*. Another specimen of *P. corymbosa* from near Cooktown (*Bredillet s.n.* August 1983) has the perennial habit of *P. multicaulis*.

***P. tenax*** I.D. Cowie, sp. nov.

*P. incana* affinis, a qua differt inflorescentiis habens paucifloribus, tubus flore praesens, partibus floribus longioribus et capsula ellipsoidea ad urceolata.

*Typus:* Nabarlek, Northern Territory, 26 April 1979, *B. Rice* 3206 (holo: DNA!; iso: BRI, CANB!).

An erect perennial herb to 10 cm tall. *Stems* numerous, hoary with branched crisped septate hairs; internodes 2-4 mm long. *Stipules* hyaline, 1.8-3 mm long, triangular, midrib present, glabrate to cobwebbed, margins ciliate, apex attenuate. *Cauline leaves* opposite, occasionally in several pairs at nodes, linear, 2-3 mm long, 0.3 mm wide, glabrous to woolly with branched or unbranched crisped septate hairs. *Inflorescence* terminal, solitary on stem, compact, 1-several flowered, subtended by 1 pair of leaves; bracts stipule-like, 3-3.5 mm long, bifid; pedicels 0.5-2 mm long. *Sepals* hyaline, lanceolate, 3.2-5 mm long, midrib present, glabrous to cobwebbed, margin ciliate, apex acute. *Petals* reddish, connate with stamens into a tube 0.5-1 mm long, oblong, 2.4-3.2 mm long, 0.6-0.8 times as long as sepals, glabrous, apex rounded. *Stamens* 1.6-2.7 mm long, 0.5-0.8 times as long as petals; filaments 1.6-2.5 mm long; anthers 0.4-0.5 mm long; staminodes absent. *Style* 1-1.7 mm long; stigma capitate. *Capsule* brown, narrowly ovoid to urceolate, 2.3-2.6 mm long, c. 0.5 times as long as calyx. *Seeds* c. 30, pale brown, dimidiate in outline, c. 0.4 mm long, 0.2 mm wide, surface reticulate-areolate or reticulate-foveolate with a minute reticulum. Figures 1F-G, 2J-L.

*Other specimens examined.* NORTHERN TERRITORY: Deaf Adder Gorge, 13° 07' S, 132° 56' E, I.R. Telford 7968 & J.W. Wrigley (CANB); 14.5 km NE of Jabiru East, 12° 33' S, 132° 59' E, M. Lazarides 9017 (CANB, DNA); Nabarlek, 12° 30' S, 133° 21' E, R. Hinz 165 (DNA); 44 km SE Oenpelli, 12° 34' S, 133° 23' E, P.K. Latz 7837 (DNA); Arnhem Land, 12° 51' S, 133° 32' E, P.K. Latz 2994 (DNA); Cadell River, 12° 39' S, 134° 18' E, D.E Symon 7888 (AD).

*Distribution.* Endemic to the Northern Territory in northern parts of Kakadu National Park and adjacent areas of western Arnhem Land.

*Habitat.* Grows in crevices in sandstone platforms.

*Flowering and fruiting.* Between February and July.

*Conservation status.* Not rare or threatened.

*Discussion.* Vegetatively this species is very similar to *P. incana* but is readily distinguished by the few-flowered inflorescences, presence of a floral tube, longer floral parts and narrowly ovoid to urceolate capsule (see also notes under *P. multicaulis*).

### Comments on other species

*Polycarpaea breviflora* F. Muell., Rep. pl. Babbage's Exped. 9 (1859).- *Polycarpon breviflorum* (F. Muell.) Kuntze, Revis. gen. pl. 1:51 (1891).- *Polycarpaea corymbosa* var. *breviflora* (F. Muell.) Domin, Biblioth. Bot. 89:101 (1925). *Type*: Gulf of Carpentaria, F. Mueller (holo: MEL).

*P. brevianthera* Ewart & Cookson, Fl. N. Territory 109 (1917). *Type*: Roper River, N.T., 1911, W. Baldwin Spencer (holo: MEL).

*P. triloba* Ewart & Cookson, Fl. N. Territory 109 (1917). *Type*: Georgina River, Qld, 1889, A. Henry (holo: MEL).

*P. parviflora* Domin, Biblioth. Bot. 89:100 (1925). *Type*: Cloncurry, Qld, Feb. 1910, Domin (holo: PR) *n.v.*

*P. synandra* var. *gracilis* Benth., Fl. Austral. 1:165 (1863). - *P. breviflora* var. *gracilis* (Benth.) Pedley, Austrobaileya 1:60 (1977). Type: Port Essington, Apr. 268/1818, A. Cunningham (isolecto: MEL), fide L. Pedley, Austrobaileya 1:60 (1977).

This species exhibits some variation in floral colouration and compactness of the inflorescence. The extremes of the variation have been recognised as varieties by Pedley (1977). Variety *breviflora* was distinguished by the spreading inflorescence and white, ovate sepals while var. *gracilis* was distinguished by the compact inflorescence and white, narrowly ovate sepals with a distinct purplish midrib. However, there are also extreme forms with very open inflorescences and purplish midribs, with more or less continuous variation between all the extremes. Some forms have hyaline rather than white sepals. The species is closely related to and is not clearly distinguished from *P. spirostylis* in inland western Queensland and adjacent areas of the central Northern Territory, from where there are a series of specimens with sepals in the 4 to 5 mm size range. However, the two species appear to be distinct in coastal areas of the Northern Territory. Specimens with sepals 4.5 mm long or less have been retained as *P. breviflora*. A detailed morphometric analysis may help resolve problems in *P. spirostylis* and *P. breviflora*.

***Polycarpaea corymbosa* (L.) Lam., Ill. Gen. Encycl. 2:129 (1797).** - *Achyranthes corymbosa* L., Sp. Pl. 205 (1753). Type: Ceylon [Sri Lanka], Herb. Herman (lecto: BM) *n.v.*, fide W.B. Turrill, Fl. Trop. E. Africa (1956).

*P. diversifolia* Domin, Biblioth. Bot. 89:102 (1925). Type: between Ashburton and Yule River, Western Australia, E. Clement *n.v.*

*P. corymbosa* var. *minor* Pedley, Austrobaileya 1:52 (1977). Type: Darling Downs, Queensland, Pedley 1234 (iso: CANB).

*P. corymbosa* var. *torrensis* Pedley, Austrobaileya 1:52 (1977). Type: Badu Is., Queensland, Bick 83 (holo: BRI).

This species has a pantropical distribution and in Australia there appear to be several forms. The most common and widespread of these has filiform, glabrous leaves which are relatively few at nodes; usually entire sepals without a distinct midrib and large cymes. A distinctive ecotype occurs on sandstone substrates in the western Top End of the Northern Territory and is generally smaller in stature with densely whorled, short, flat, hairy, narrowly oblanceolate leaves, sparser inflorescences and ciliate, ribbed sepals. Another form found around the Gulf of Carpentaria and on islands of Torres Strait has long, narrowly ovoid fruit and subcylindrical seeds. In the past, specimens from this area with short internodes and more distinct midribs, some with the above fruit and seed characters have been referred to *P. corymbosa* var. *torrensis*. Perennial forms with relatively small flowers and often with reddish sepals and a more dense indumentum occur in some inland areas and grade into *P. multicaulis*. Some of these have been referred to *P. corymbosa* var. *minor* which was distinguished by the smaller flowers and reddish bases on the sepals. Turrill (1956) working on east African material noted that the species is extremely variable and commented that it appears "of doubtful value to give names to slight variants until modern methods of synthetic taxonomy...have been applied to the whole group". These comments could equally well apply to *P. spirostylis* and some other species.

*Polycarpaea diversifolia* is here regarded as a synonym of *P. corymbosa*. Pedley (1977) stated that the two species differ in that *P. diversifolia* is annual and has obscure folds inside the petals at the base (a minute corona). He used as a key character the presence of persistent, broad basal leaves. However,



*P. corymbosa* in northern Australia is nearly always annual and has a minute corona. Also, there are a number of shorter specimens of *P. corymbosa* in which the basal leaves have persisted (e.g. *Evans* 3641; *Fryxell & Craven* 4078; *Latz* 9490, 10696; *A.S. Mitchell* 230, 714, 1203). *Adams* 952, the only specimen of *P. diversifolia* which *Pedley* cited (apart from the type) is clearly one of these. Basal leaves are sometimes persistent in other Australian species (e.g. *P. arida*, *P. holtzei*, *P. involucrata*) as well as the east African *P. eriantha* (*Turrill* 1956) but are of little taxonomic significance. Also, both *Pedley's* and *Domin's* descriptions of *P. diversifolia* are otherwise consistent with that of *P. corymbosa*.

***Polycarpaea involucrata*** F. Muell., Rep. pl. Babbage's Exped. 9 (1859). *Lectotype*: Sturt's Creek and Upper Victoria River, March 1856, *F. Mueller* (MEL 49074) *lecto. nov.*

This species has affinities with *P. arida*, *P. incana* and *P. microceps*, but is distinguished by the annual habit; sessile, capitate inflorescences which are both axillary and terminal; flowers consistently on short pedicels; and oblanceolate, hairy leaves which are in several pairs at nodes. Several intergrading forms of the species are known. Diminutive forms with smaller floral parts occur in the northern Kimberley. A few of these have hoary stems and are perennial (e.g. *Cowie* 4357), and one (*Fryxell* 4726) in part lacks axillary inflorescences and approaches *P. incana*. West of Mitchell Falls, these diminutive annual and hoary perennial forms have been observed growing side by side. Some small flowered specimens also have red-brown bracts and sepals. Further collecting of these forms is needed.

In central Australia, where *P. involucrata* is sympatric with *P. arida*, there is a distinct form of *P. involucrata* with slightly more open inflorescences than the typical form. The two species occur in different habitats with *P. involucrata* occurring in crevices on sandstone outcrops (as elsewhere) and *P. arida* on flat country on areas receiving local run-on water.

***Polycarpaea spirostylis*** F. Muell., Rep. pl. Babbage's Exped. 8 (1859). - *Polycarpon spirostyle* (F. Muell.) Kuntze, Revis. gen. pl. 1:51 (1891). *Type*: Tropical Australia, *F. Mueller* (holo: MEL).

*P. synandra* F. Muell., Rep. pl. Babbage's Exped. 8 (1859). - *Polycarpon synandrus* (F. Muell.) Kuntze, Revis. gen. pl. 1:51 (1891). *Lectotype*: Victoria River, 1855-56, *F. Mueller* (lower, right-hand specimen of MEL 49121) (MEL) *lecto. nov.*

*P. synandra* var. *densiflora* Benth., Fl. Austral. 1:165 (1863). - *P. spirostylis* subsp. *densiflora* (Benth.) *Pedley*, Austrobaileya 1:59 (1977). *Type*: Cape Flinders, [14° 08'S, 144° 14'E], July 13/1819, *A. Cunningham* (lecto: K), *fide* L. *Pedley*, Austrobaileya 1:59 (1977), *n.v.*

*P. burtonii* F.M. Bailey, Proc. Roy. Soc. Queensland 1:85 (1885). - *P. spirostylis* var. *burtonii* (Bailey) *Domin*, Biblioth. Bot. 89:99 (1925). *Syntypes*: Walsh Range, between the Tate River and Thornborough, Qld, *R.C. Burton* (BRI *n.v.*; isosyn: MEL 49038); *Herberton*, *Stuart* (BRI *n.v.*)

*P. spirostylis* var. *intercedens* *Domin*, Biblioth. Bot. 89:100 (1925). *Type*: Walsh R., Qld, Feb. 1910, *Domin* (holo: PR) *n.v.*

*P. spirostylis* var. *intricata* *Domin*, Biblioth. Bot. 89:100 (1925). *Type*: Burketown, Qld, *L.C. Ball* (holo: PR) *n.v.*

*P. spirostylis* var. *rosulans* Domin, Biblioth. Bot. 89:100 (1925). Type: Chillago, Qld, Feb. 1910, Domin (holo: PR) *n.v.*

*P. glabra* White & Francis, Proc. Roy. Soc. Queensland 37:152 (1926). - *P. spirostylis* subsp. *glabra* (White & Francis) Pedley, Austrobaileya 1:58 (1977). Type: Dugald silver-lead lodes, Cloncurry District, Queensland, J.B. Miller, 16th April 1924, *n.v.*

*P. gamopetala* Berhaut, Bull. Mus. Hist. Nat. (Paris) ser. 2, 25:210 (1953). Type: Senegal. Ex. herb. DC., Herb. Moquin-Tandon (holo: PR) *n.v.*

*P. spirostylis* subsp. *compacta* Pedley, Austrobaileya 1:59 (1977). Type: Croydon, Queensland, Speck 4720 (iso: CANB, MEL).

Mueller gave the type localities for *P. synandra* as “Wirrawirraloo. Also in Arnhem’s Land and in other parts of tropical Australia.” The Wirrawirraloo specimen was not located by Pedley (1977) although he discussed a sheet at MEL (MEL 4912). The Victoria River specimen on that sheet is almost certainly another syntype, since that locality lies within Mueller’s concept of Arnhem Land, is annotated as *P. synandra* by Mueller and was collected by him several years prior to publication of the description of that species. This specimen also fits the description given by Mueller. Although the Wonamulla specimen on the same sheet is probably from about 150 km north-west of Wirrawirraloo (Pedley 1977), there is no evidence that it predates the description of *P. synandra*.

Although *P. spirostylis* is variable in flower size, lobing of the petals and compactness of the inflorescence, no sharp discontinuity in the variation is apparent and circumscription of the previously recognised subspecies is regarded as arbitrary. The apex of the petals varies continuously from deeply bifid in the northern Northern Territory to entire in some parts of north Queensland. Lobing of the petals also tends to be less pronounced in specimens with smaller flowers. Although some forms have more compact inflorescences, this character has little geographical basis and is not correlated with the lobing of the petals, with flower size, degree of colouration or vegetative characters. Specimens from more southerly and more inland localities tend to have shorter flowers, although all sizes of flowers can be found in some northern areas. Sepal length reaches a maximum in populations from Cape York (13 mm) with specimens from the Top End of the Northern Territory reaching 9.7 mm.

**Polycarpaea violacea** (Mart.) Benth., Fl. Austral. 1:165 (1863). - *Aylmeria violacea* Mart., Nova Acta Phys.-Med. Nat. Acad. Caes. Leop.-Carol. Nat. Cur. 13:277 (1826). - *Achyranthes violacea* (Mart.) Sprengel, Syst. veg. 4(2):102 (1827). - *Polycarpon violaceum* (Mart.) Kuntze, Revis. gen. pl. 1:51 (1891). Type: Croker Is., Northern Territory, 1818, A. Cunningham 267 (iso: BRI, MEL).

*Aylmeria rosea* Mart., Nova Acta Phys.-Med. Nat. Acad. Caes. Leop.-Carol. Nat. Cur. 13:277 (1826). - *Achyranthes rosea* (Mart.) Sprengel, Syst. veg. 4(2):103 (1827). Type: Ex herb, Lambert, *n.v.*

*P. fallax* Pedley, Austrobaileya 1:51 (1977), *nom. illeg.*, non J. Gay ex Oliver, Fl. T. Af. 1:145 (1868). Type: Port Bradshaw, Northern Territory, July 1948, R. Specht 708 (holo: BRI; iso: MEL).

Colourless forms of this species have been described as *P. fallax* by Pedley (1977) who separated *P. violacea* by its glabrous stems, shorter capsule and coloured sepals. However, the supposed lack of an indumentum in *P. violacea* appears to be an error as Bentham stated that the stems are hairy and of

the five specimens cited by Pedley the four seen (including the isotypes) have hairy stems. All other material with reddish sepals which had been referred to *P. violacea* also has hairy stems.

Pedley (1977) also separated the species on capsule length which he gave as c. 1/3 the length of the corolla in *P. violacea* and at least 1/2 the length of the corolla in *P. fallax*. However, the type of *P. violacea* has capsules subequal in length to the petals and in almost all mature specimens of both major colour forms the capsule is more than 2/3 the length of the petals. Some specimens of both major colour forms have immature fruit and this may well be the basis of the supposed difference.

Sepal colour was also used to separate the two species but as a character in isolation is not sufficient to maintain the species as separate. Colouration of sepals ranges from occasionally almost completely coloured (Wightman 370, 3441; Hinz 27), through partly coloured (coloured tops and hyaline bases - common) to completely hyaline (also common). There are occasional intermediate forms where the sepals are hyaline with coloured midribs (Cowie 2769, 2921) or where coloured and hyaline flowers occur in the same inflorescence (e.g. McKean B486, Wightman 3827, Musprat 2948). At a gross level the ranges of both major colour forms largely overlap, although they rarely grow together. Coloured forms occur in near-coastal areas of the Top End of the Northern Territory, while colourless forms occur across the entire range of the species.

The compactness of the inflorescence and staminode length also varies. Forms from the Kimberley and Victoria River regions have less compact inflorescences and longer staminodes than those from the northern and eastern Northern Territory.

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